Transforming the National Airspace System

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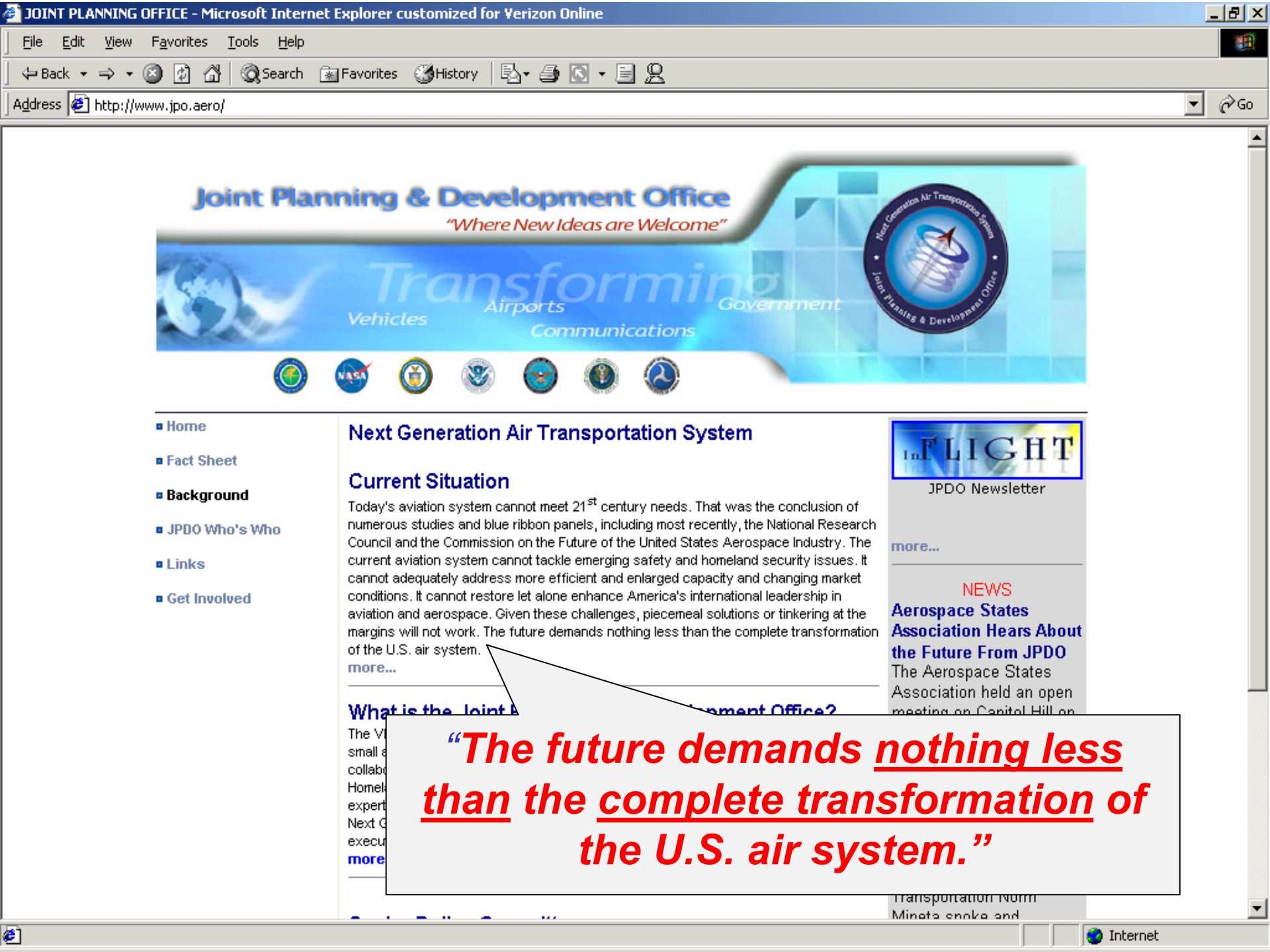
Why Transformation?

- The current aviation system does not scale to meet future needs related to*
  - Aircraft
  - Airports
  - Airspace
  - Commerce and Business models
  - Environmental considerations
  - Security and safety considerations
- Evolution and modernization plans do not lead us to the changes needed beyond 2015
- Transformation requires change across government agencies
- The results of transformation produce new business models, new regulatory models, and new uses of airspace, airports, and aircraft
- The outcome of transformation is to enable scalability to meet the nation's needs in commerce, mobility, security , and safety

*From NRC Report ("System in Peril" 2003)
and the President's Commission Final Report (2002)


JOINT PLANNING OFFICE - Microsoft Internet Explorer customized for Verizon Online
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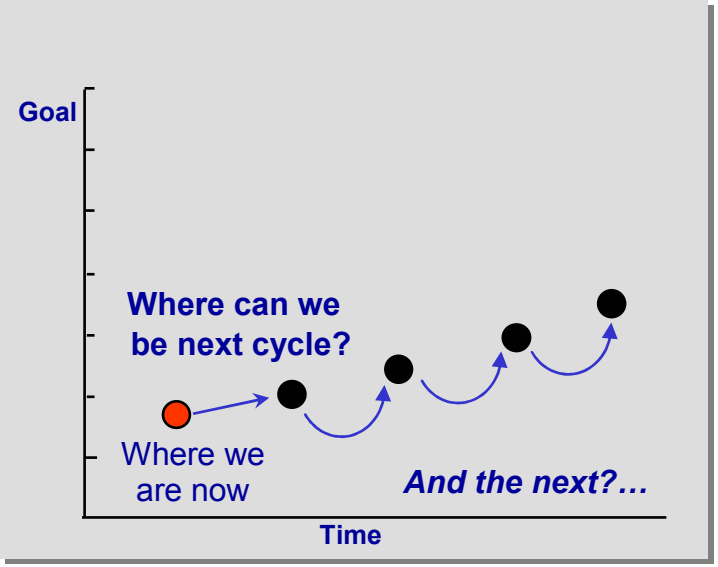
Next Generation Air Transportation System
Current Situation
Today's aviation system cannot meet 21st century needs. That was the conclusion of numerous studies and blue ribbon panels, including most recently, the National Research Council and the Commission on the Future of the United States Aerospace Industry. The current aviation system cannot tackle emerging safety and homeland security issues. It cannot adequately address more efficient and enlarged capacity and changing market conditions. It cannot restore let alone enhance America's international leadership in aviation and aerospace. Given these challenges, piecemeal solutions or tinkering at the margins will not work. The future demands nothing less than the complete transformation of the U.S. air system.
more...
InFLIGHT
JPDO Newsletter
more...
NEWS
Aerospace States Association Hears About the Future From JPDO
The Aerospace States Association held an open
"The future demands nothing less than the complete transformation of the U.S. air system."
Internet

Today's pace of change demands context-derived project planning & execution

Incremental Execution

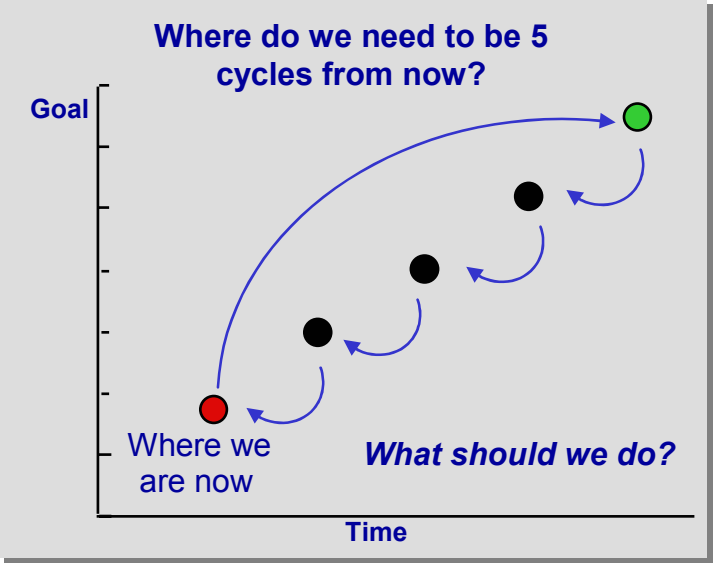
- *Negotiation-Derived Strategies*



Current Projects

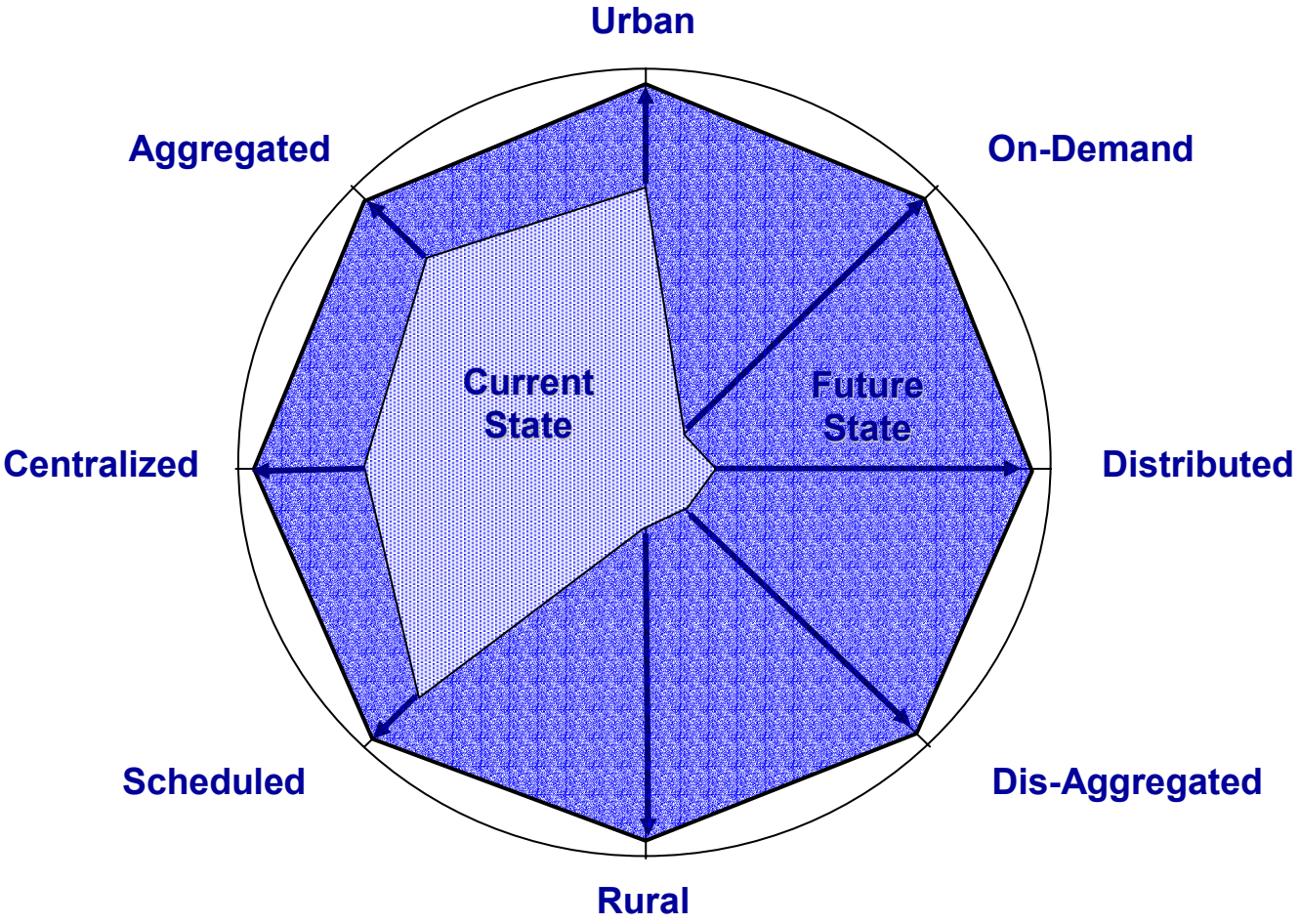
Strategic Thinking

- *Context-Derived Strategies*



JPDO Influenced Projects

Notional Transformation Concept Space

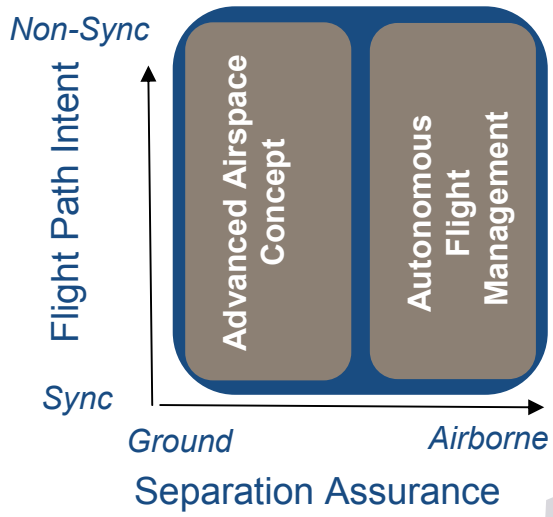


The vision includes expanding scalability along all dimensions.

Transforming the NAS: Scope

System Evaluation and Engineering

Transformational Operations



Dynamic Traffic Flow Prediction/Management

Optimized Surface Operations

Capacity Enhancing Aircraft Systems

Rqmts

- En Route
  - Oceanic
  - Low density
  - Complex
- Term/Airport
  - High Density
  - Non-Towered

Advanced Capabilities

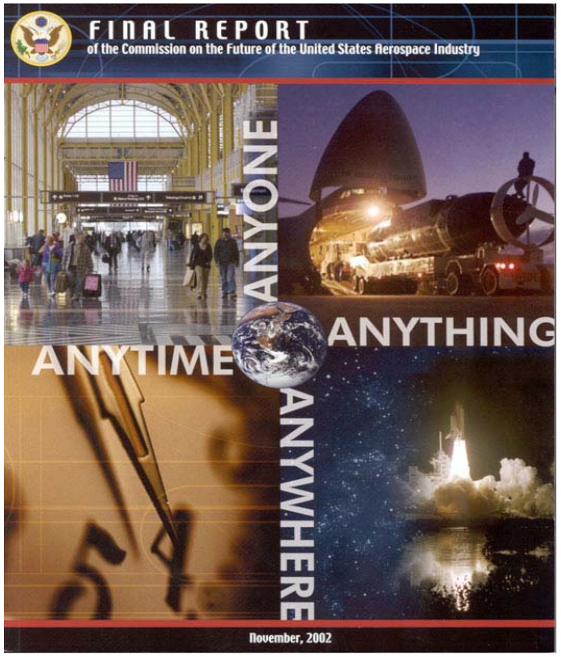
Quality of Information
- Weather
- Precision CNS

Information Sharing
- Airspace mobility communication networks
- SWIM selected information technologies
  - Management
  - Dissemination
  - Control

UAV Operations

University/Base Research

Commission on the Future of the United States Aerospace Industry



Conclusions:

Chapter 2 – Air Transportation: Exploit Aviation's Mobility Advantage

- Deploy a New, Highly Automated Air Traffic Management System.
  - "The core of an integrated 21st century transportation system will be a ***common advanced communications, navigation and surveillance infrastructure*** and modern operational procedures."

Chapter 3 – Space: Its Special Significance

- Develop a Next Generation Communication, Navigation, Surveillance and Reconnaissance Capability.
  - "The nation needs real-time, ***global space-based communications, navigation, surveillance*** and reconnaissance systems for a wide range of applications."
  - "The civil and commercial sectors will also benefit from these capabilities for air transportation management, monitoring global ***climate change, weather forecasting*** and other applications."

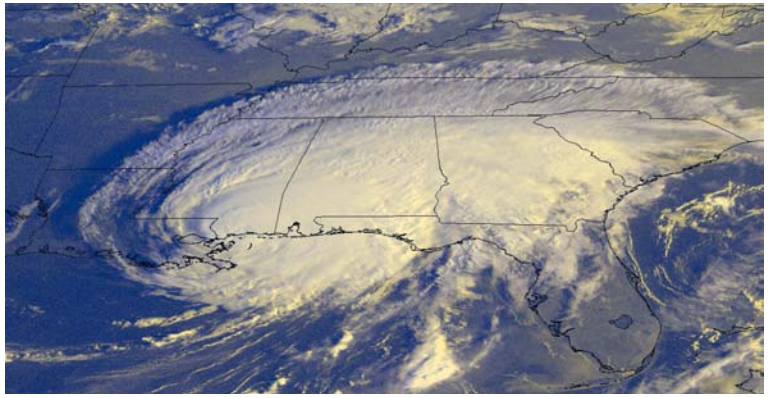
Derived Requirements

Core Services	Comm	Nav	Surv	Weather	Networks
• Flight Planning	✓				✓
• Separation Assurance			✓		✓
• Advisory	✓		✓	✓	✓
• Tactical Traffic Management	✓				✓
• Strategic Traffic				✓	✓
• Emergency and Alerting	✓	✓	✓		✓
• Navigation		✓			
• Airspace Management	✓		✓		✓
• Infrastructure/Information	✓				✓
Key Characteristics					
• Airport Systems	✓	✓	✓	✓	✓
• Security/Homeland Defense	✓		✓		✓
• Aircraft	✓	✓	✓	✓	✓
• Flight Operational Control	✓	✓			✓

Transforming the NAS – Advanced Capabilities
Weather Products for NAS Operations

Objective

- Accelerate the development and integration of advanced aviation-weather products with ATM Decision Support Tool (DST) technologies to improve the accuracy of forecast products and their relevance for current and future ATM decision making, to efficiently increase airspace capacity within the future National Airspace System (NAS).



Tasks

- Weather products tailored to support the transformed NAS
  - Integration of weather products and Decision Support Tools (DSTs) for ATM/TFM
  - Weather requirements for the future NAS
  - Research DST needed for an Automated Airspace
- Advanced technologies for weather forecasting
  - 0-2 hour forecast & 2-6 hour forecast products
    - Improved deterministic-forecast capabilities and development and validation of probabilistic forecast products
    - Improved identification and display for traffic flow management
  - Validation of ATM/TFM weather products
  - Development of prediction probability/uncertainty models for ATM application
  - Leverage space-based sensing and data processing technology for aviation weather

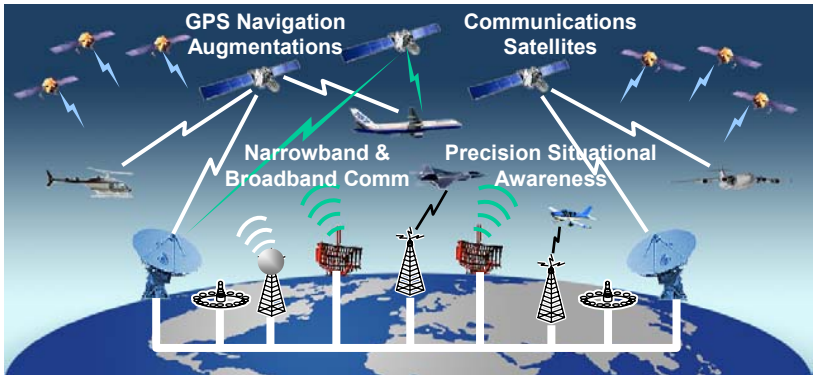
Deliverables

- Tailored weather products for transformed NAS
  - Defined weather products and requirements for the future NAS
  - Integration of weather DST for ATM as part of a collaborative environment developed and tested
  - Weather and DST technical community collaborations through interdisciplinary research teams
  - Developed concepts for Weather DST in an automated airspace
- Advanced technologies for weather forecasting
  - Improved 0-2 hour hazardous convective forecast models
  - Accurate and reliable 2-6 hour aviation forecast products
  - Development and validation of probabilistic forecast products
  - Improved sensors, algorithms and technologies to support forecast products

Transforming the NAS – Advanced Capabilities
Precision CNS Systems

Objective
- Transform currently segregated communications, navigation and surveillance systems into a seamless, integrated digital and precise system to enable new airspace use, new ATM paradigms and new vehicle types and increase the capacity of the National Airspace System.

Tasks
- Develop and evaluate system-level technologies
  - Define and assess the requirements for secure, high bandwidth digital communications, precision navigation, and accurate situational awareness
  - Develop and evaluate the required total system performance for new airspace use and new ATM mechanisms
  - Develop and evaluate the requirements, gaps, and benefits of transformation into an integrated system
  - Develop and demonstrate technologies to enable increased spectrum utilization
  - Evaluate space based CNS system options through analysis and simulation
- Develop selected avionics
  - Develop selected technologies to provide secure, high bandwidth digital communications
  - Develop selected technologies to improve the precision and reliability for navigation and situational awareness
  - Assess the impact of technology infusion in the form of new or enhanced avionics upon legacy equipage and infrastructure
  - Develop selected avionics for technology evaluation



Deliverables
- System-Level Definition
  - Integrated CNS system architecture
  - Required total system performance metrics (RTSP)
  - Quantity and location of CNS system elements
  - Advocacy for spectrum utilization in international forums
- Communications, navigation and surveillance technology evaluations for transforming the NAS
  - Wireless link characterizations of performance, spectral efficiency and security
  - Augmentations for GPS navigation
  - Augmentations for radar surveillance
- New and/or enhanced avionics ready for technology evaluation
  - Integrated components or functions
  - Digital, cognitive, and adaptable to enable greater precision, efficiency, and flexibility of services
  - Physical and functional interfaces to enable Airspace Mobility Communication Network capabilities

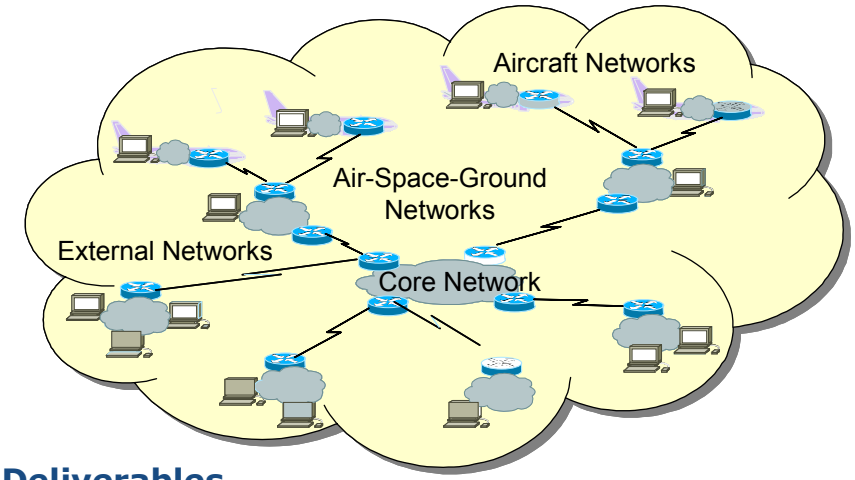
Transforming the NAS – Advanced Capabilities
Airspace Mobility Communication Networks

Objective

- Leverage advancements in communications networking (connectivity, capacity, mobility, security and interoperability) to achieve improved decision making via sharing of data, information, and knowledge across all elements and domains of the National Airspace System in a secure, timely, and effective manner.

Tasks

- Develop candidate airspace mobility comm network designs
  - Project integrated communications needs across the NAS
  - Develop transformational network design options
  - Conduct selected system level cost/benefits analyses
- Develop selected enabling comm and network technologies
  - Low-cost air-to-air, -space, -ground communications
  - Interoperable mobile IP network components
- Conduct communication network design trade studies
  - Physical and datalink layers design options and technology requirements
  - Network and transport layers mobile and secure protocols and technology requirements
  - Interface descriptions for: mobile/terrestrial data networks; CMU/FTI/IMU; and NAS/External users
  - Regulatory, standards and policy for use of IP
- Validate network concepts and technologies
  - Simulations and demos to validate critical concepts



Deliverables

- Airspace communications network development
  - Communications and connectivity needs projection
  - Physical/functional design and system specifications
  - Concepts of operations and transition scenarios
  - Cost/benefit analyses of selected elements
- Selected system trade study results
  - Physical, datalink and network layer protocol designs
  - Technology requirements and cost goals
  - Network interfaces definition and requirements
  - Regulatory, standards and policy impact assessments
- Selected enabling technologies
  - Airspace comm network capabilities and components
- Concept validation
  - System-level simulation and models
  - Selected proof-of-concept demos in relevant environments

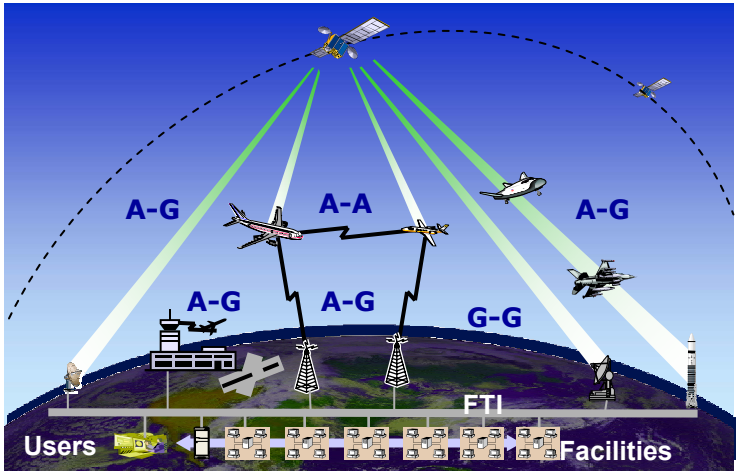
Transforming the NAS – Advanced Capabilities
Technologies for System Wide Information Management

Objective

Develop end-to-end information management architecture concepts for integrated and secure system-wide information management, dissemination and control and develop enabling data fusion, mining and common information networking technologies for data and information access and sharing across all domains of the NAS

Task Areas

- Systems Evaluation and Engineering
  - System Requirements Studies
  - Project Management and Administration
  - Project Integration
- Operational concepts and information architectures
  - Information Architecture Studies: Open architecture and common information networks for interoperability and SWIM
  - Operations Concept Evolution: Requirements, IT architecture, comprehensive connectivity, gaps and benefits
- Automated Data Distribution and Management
  - Data definition and processing
  - Security and Integrity Assurance
  - SWIM Engineering for Automated Airspace Operations
- Proof-of-concept components tested in a relevant environment
  - Situational Awareness and Decision Support
  - System-wide ops simulation and modeling
  - Ground and air demonstration/validation tests



Deliverables

- Bridging legacy systems to improvements
- Candidate evolvable and extendable architectures
- Proof-of-concept information tools
  - Data fusion and mining
  - Intelligent Management, security and integrity of system-wide information
  - Data to support transformational operations
- Proof-of-concept system simulation with SWIM tools and components

Transforming the NAS: Secondary Emphasis
Affordability – Certification and Standards

- Provide Certification Process and Airborne Equipage Innovation
  - The Commission calls for a new approach to the regulation and certification of ***aircraft technology***, processes and procedures.
    - Shift from product to process certification.

    [Source: Final Report of the Commission on the Future of the United States Aerospace Industry, Chapter 2 Conclusions, December 2002]

- Research Needs Beyond Technology Development
  - "The federal government should also ***support research*** in the following non-technology areas:
    - Modification of regulations, certification requirements, and operating procedures."

    [Source: NRC Committee on Aeronautics R&T for Vision 2050, Recommendation 2.4, September 2003]

Transforming the NAS
Affordability – Certification and Standards

Objective

- Develop and evaluate new approaches to certification and upgrade of avionics, and interoperability of communications network standards, to significantly reduce the cost and time required to infuse transformational communications capabilities into the NAS with no impact on safety.

Task Areas

- **Avionics Certification Methodology**
  - Assess current process for certification of CNS avionics and identify critical bottlenecks.
  - Develop options for rapid, safe, cost-effective processes for certification and re-certification of software-defined, multi-function avionics.
- **International Interoperability Standards**
  - Assess emerging standards in ATN and Internet Protocol for strengths and weaknesses for aviation.
  - Develop IPv6 mobility enhancement options for multi-homing and policy-based routing and collaborate with Internet Engineering Task Force and Eurocontrol for standards infusion.
- **Cost Benefit Analyses**
  - Conduct cost/benefit analyses for both certification methodology options and interoperability options.
  - Identify areas where R&T investments in certification and standards have potential significant impact.

Deliverables

- **Avionics Certification Methodology**
  - Certification process bottlenecks
  - Proposed methodology for software-defined multi-mode avionics
- **International Interoperability Standards**
  - ATN and IP aviation mobility assessments
  - Mobility enhancement options for IPv6
- **Cost Benefit Analyses**
  - Analysis findings
  - Recommendations for R&T investments

Transforming the NAS: End State*

Challenges

Retaining Leadership in the Global Aviation Industry
Integrating Capabilities to Ensure our National Defense
Ensuring Capacity
Securing the Nation
Ensuring Safety
Protecting the Environment

Characteristics

Situational awareness - coop/non-coop surveillance
Ubiquitous access/Integrated response
Seamless service - civilian and military users
Scalable systems
Information technology
Automated, intelligent procedures/systems
New vehicles and tailored ops procedure
Communication systems
Navigation systems
Spectrum
Networking technology
Virtual air traffic management

Improved weather forecasts
Strategic decision support tools
Crash/Fire resistant
Quieter Aircraft
Fuel efficient flight profiles
Land use policy

Reduce Weather Impacts
Utilize Space-based Assets
Employ Information Sharing

***End-State Description of the Next Generation Air Transportation System, July 2004**